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HONEY BEES: BENEFICIAL ROBBERS!

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ABSTRACT

Honey bees are most important pollinators around the world and are major pollinators in tropical ecosystems. Honey bee visits the flowers to obtain their food and in return pollinate them. Bee pollination as a new agricultural production strategy has huge possibilities. Profitable crops like onion, sunflower, Apple and cucurbitaceous crops are specifically reliant upon or are benefited by honey bee pollination. Apart from the beekeeping products bee pollination benefits society by increasing food security and improving live hoods.

KEYWORDS: Honey Bee, Pollination, Foraging, Crops

INTRODUCTION

Pollination by animals is an important ecosystem service because crop plants accounting for 35% of global crop-based food production benefit from animal-mediated pollination. Flower-visiting insects, such as bees and butterflies, contribute to farmland biodiversity of habitats. They have an important functional role as pollinators of wild plants and several crop species (Klein *et al*., 2007).

Bees (Hymenoptera: Apiforme) the primary pollinators for most of the crops requiring animal pollination (Delaplane and Mayer, 2000; Free, 1993; Klein *et al*., 2007). In much of the world, the cornerstone of agricultural pollination is the managed honey bee (*Apis mellifera*). Honey bees, which are native to Europe and Africa but not North America, are maintained in hives which are moved into agricultural areas during crop bloom. Despite the honey bees effectiveness as a pollinator for many crops, there are risks associated with reliance on a single, managed pollinator species. Managed honey bee stocks in the USA have decreased steadily since the 1940s, and are now at less than half their original numbers (Ellis *et al.*, 2010).

Effective pollination period (EPP) has been considered (Honsho *et al*., 2007; Sanzol and Herrero, 2001) to be an important tool to detect factors limiting fruit set. The nature and behaviour of pollinators, quality and quantity of pollen that reach to stigma, site of pollen delivery and quantity and quality of nectar are major biotic factors influencing effective pollination and fruit set in plants (Endress, 1994; Corbett, 2003). The pollen:ovule ratio is also an indicative of degree of out-crossing and mode of pollination. Low P/O ratio indicates autogamy and high xenogamy (Cruden, 2000; Jurgens *et al*., 2002; Stefan, 2009). Pollen load, visitation frequency and pollen delivery vary with the insect species (Ivey *et al*., 2003; Monzon *et al*., 2004 and Stout, 2007) and in general, visitors with high pollen load and visitation frequency are considered efficient pollinators.

The Importance of Honeybees as Pollinators

Honeybees play an important role for cross-pollination, which is important for both monoecious and dioecious plant species. Without this assistance, fruit and/or seeds would not be formed for most flowering species. Many agricultural crops such as *Aeschynomene americana* L., *Ageratum conyzoides* L., *Amomum xanthioides* Wall., *Anacardium occidentale* L., *Antigonon leptopus* Hook. *Balakara baccata* Roxb., *Castanopsis acuminatissima* Rehd., *Cinnamomum kerrii* Kosten, *Coccinia grandis* CL.Voigt, *Cocos nucifera* L., *Coffea Arabica* L., *Conyza sumatrensis* Retz are pollinated by honeybees (Suwannapong *et al*., 2011).

Honeybees of the genus *Apis* are the most studied because of their fascinating and complex lifestyle, communication systems (Nieh, 1998; Nieh and Roubik, 1995), role as keystone pollinators of native plants, pollination of agricultural crops, and the valuable hive products that they produce, such as honey, royal jelly, bee wax, bee pollen, propolis and even bee venom.

In contrast to the sole species of honey bee, there are at least 17,000 species of native, wild bees worldwide (Michener, 2007). Many of these species visit crops (Delaplane and Mayer, 2000; Klein *et al*., 2007), and they contribute substantially to the pollination of such crops as coffee *Coffea spp*. (e.g. (Klein *et al*., 2003), watermelon *Citrullus lanatus* (Kremen *et al*., 2002; Winfree *et al*., 2007), tomato *Solanum lycopersicum* (Greenleaf and Kremen, 2006a), blueberry *Vaccinium spp*. (Cane, 1997; Isaacs and Kirk, 2010), sunflower *Helianthus annuus* (Greenleaf and Kremen, 2006b) and canola *Brassica spp*. (Morandin and Winston, 2005). These native bees provide pollination thus directly benefiting crop production. In addition, they complement in a number of ways the service provided by honey bees: biologically, by enhancing the efficacy of honey bee pollination in some cases (Greenleaf and Kremen, 2006b), and economically, by insuring against pollination shortages. Having accurate estimates of this value could improve land use planning by quantifying the costs and benefits of conserving habitat for pollinators in agricultural systems.

Insect and other organisms play major role in boosting agricultural production by significantly increasing the yields of crops, vegetables, fruits and seeds through visiting flowers and helping in pollination (Pashte and Kulkarni, 2015). Self-incompatible and cross-pollinated crops require pollinating service of efficient pollinators. Self-pollinated crops also benefit from insect pollination, that increase yield up to 30% from pollinator visits and also collection of nectar or pollen and benefit farmers from pollinators' service. Lack of pollinators causes decline in fruit and seed production (Partap, 2001).

POSITION OF HONEY BEE IN ASIA

Asia has a rich diversity of honeybee species. These include *Apis cerana, A. dorsata, A. florea, A. laboriosa, A. breviligula, A. binghami and A. andreniformis* that are indigenous to the region, whereas the European honeybee, *A. mellifera* was introduced to the region and promoted for beekeeping. The indigenous honeybees make a significant contribution to the livelihoods of the rural poor and protection of the environment through a variety of products and services (Partap, 1992). There is timely need for better management of hive honeybees such as *A. cerana* and *A. mellifera* in rare pollinator areas to increase fruit production. Information on the role of honeybees in pollination leads to increased quality and yield of crops worldwide (McGreger, 1976; Crane, 1991; Free 1993; Partap and Verma, 1994; Suwannapong *et al*., 2011).

FORAGING BEHAVIOUR

Honeybees collect the nectar and pollen of flowers as food for their colony. When performing this task, honeybees show flower constancy (Abrol); individual honeybees exclusively visit flowers of the same species as long as nectar is provided. However, honeybees are not explicitly specialized to forage on specific flower species.

They are generalists in their ability to learn the color, odor and shape of all kind of flowers (Backhaus, 1993). Honeybees have ability to learn and remember the color, shape, and fragrance of flowers that are bountiful in these nutrients, and also how to get to them. A bee can learn a new color in about half an hour (after it has made about five visits to collect a food reward), a new pattern in about half a day (after 20–30 rewarded visits), and a new route to a food source in about 3 to 4 visits. It can learn to visit different species of flowers at different locations, at different times of the day (Srinivasan, 2010).

There are differences among flowering plant species with respect to nectar and pollen production. Not all plant species possess nectaries (glands secreting nectar) or have nectar that bees can reach with their proboscis (tongue) (Partap, 1992). Nectaries can be located in various areas of the flower and some species have extrafloral nectaries that may be visited by bees. In addition, some bees may perform nectar robbing, making a small hole at the base of a flower in order to obtain the nectar. In this case, the bee does not perform any pollination service for the “robbed” plant.

Honeybees are unlikely to make many repeat visits if a plant provides little reward. A single forager will visit different flowers in the morning and, if there is sufficient attraction and reward in a particular kind of flower, she will make visits to that type of flower for most of the day, unless the plants stop producing reward or she detects forage-marking pheromones left by other bees to avoid revisiting the nectar-depleted flower.

Honeybee body are covered with abundant setae which pollen grains are attached while she forage both for nectar and pollen. They make pollen to be pellets with nectar and carry them by pollen baskets on the hind tibiae and storage in the pollen storage area (Partap, 1992). In addition to collecting nectar and pollen, foragers can collect plant gum (propolis) and water (Marcucci, 1995; Bankova *et al*., 1983, 2000). All crops which are mostly visited and benefited by bees are reviewed in Table 1.

At the present day, there is now a general increased awareness for habitat management that may help pollinators likely to increase. Discovering potential pollinators, devising management techniques, and increasing their population for commercial exploitation will take several years. Research studies are needed in this direction to conserve honeybees and other natural pollinators, exploit their potentiality in crop pollination and allow them to develop in the pollution free environment.

CONCLUSIONS

The effectiveness of honeybees in crop pollination depends on many factors, such as the location of the hives, the attractiveness of the flowers to the bees, and the bees' behaviour in approaching the flowers. The number of colonies varies considerably according to the crop: many fruit crops require several strong hives per hectare. To ensure that a large proportion of the flowers are visited, the bees should be moved to the area as soon as blossoming begins or, preferably, just before.

A number of factors can to some extent limit the efficiency of bees as pollinators: competition from nearby

flowering plants, such as weeds; colony weaknesses brought about by the effects of pesticides, bee diseases and negligence during the pollen flow; and the effects of poor weather, which may prevent the trees from flying. Special emphasis should be placed on the danger of pesticides: while colonies of bees are in the field for pollination, toxic pesticides must not be used in the area, and in this regard, cooperation between growers and beekeepers is of the utmost importance.

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APPENDICES

Table 1: Crops Mostly Visited and Benefitted by Bees

Radish	Kermer (1945), Verma and Poghat (1994), Uma and Verma (1994), Priti *et al.* (2001), Kapila *et al.* (2002)
Mustard	Annelise de Souza Rosa1*et al.*(2011), Singh *et al*.(2011), Landridge and Goodman (1975), Froster *et al*. (1973), Abel *et al*. (2003), Lerin (1982), Bisht *et al*. (1983), Prasad *et al*. (1989), Singh and Chamotre (1992), Chand and Singh (1995), Verma and Joshi (1983), Sihag (1986), Khan and Chaudhary (1988), Mishra *et al.* (1988), Harichand and Singh (1995), Singh *et al*.(2002), Murasing (2000), Ahmed and Rehman (2002)
Safflower	William (2003), Lingappa *et al*., (1999)

Table 1: Contd.,	
Sunflower	Free (1970), Furgula *et al.*(1979), Rakeshkumar *et al*. (1994), Swaminathan and Bharadwaj (1998), Vaishampayan and Sinha (2000). (Kumar *et al.* 2002), Viraktmath and Patil (2002)
Cotton	Ganapathi, 2005
Niger	Guruprasad (2001), Ramachandran and Menon (1979), Kulkarni and Dhanorkar (1998), Sattagi *et al. (*2004), Sunder rajurs (2001), Sattagi *et al*. (2001b),
Carrot	Goyal *et al.* (1989), Kumar *et al.* (1989)
Watermelon	Elstrom and Maynard (1991), Sattagi *et al*. (2001a)
Cauliflower	Verma and Partap (1994)
Sesamum	Patil (1999), Rakeshkumar and Lenin (2000), Pashte and Shylesha (2013a), Pashte and Shylesha (2013b), Pashte and Shylesha (2013c), Pashte and Shylesha (2013d),
Cucumber	Suhail *et al.* (2001), Solange *et al.* (2008)
Onion	Mohammad *et al*. (2011), Zdzisaw Wilkaniec *et al.* (2004)
Apple	Langridge (1969)